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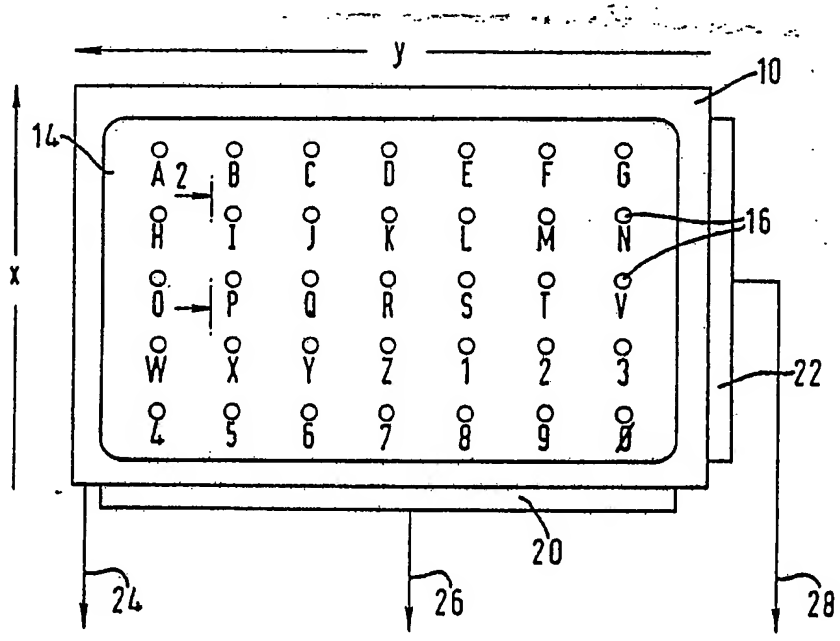
(54) Title: DATA INPUT DEVICE



(57) Abstract

A sheet (10) of known acoustic properties, e.g. glass, has ultrasonic transducers (20, 22) along adjacent edges. Depressing a chosen key (16) causes an impact on the sheet (10). The transit time for the acoustic wave to reach the transducers (20, 22) enables the x,y coordinates, respectively, of the point of impact to be established and these may be used to define an alphanumeric character via a look-up table. A graphics version using a stylus is also described.

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"Data Input Device"

DESCRIPTION

This invention relates to a data input device for the manual input of data to such apparatus as digital computers.

The commonest form of input is alphanumeric by means of a keyboard. Conventional keyboards are relatively complex mechanically and in electronics, and consequently suffer from high initial cost and low reliability. One object of the present invention is to provide a cheaper and more reliable keyboard. The invention also seeks to provide a keyboard-type input device and an input device which digitises analog information.

In a broad aspect, the invention resides in a data input device comprising:

a sheet of material having known acoustic transmission properties and having two edges at an angle to each other (preferably a right angle);

first and second acoustic transducers each arranged on one of said edges and responsive to the receipt of an acoustic pulse at the respective edge to provide a corresponding electrical signal; and

reference signal means associated with said sheet and operative to provide a reference signal in response to an acoustic event at any point on the sheet.

It is possible for the input device as thus defined to operate in conjunction with a computer simply by use of suitable software, as will be discussed below. More commonly, however, the device would include circuitry to provide a digital alphanumeric or graphic output to a computer or other user device. To this end, the device preferably further includes:

first and second signal processing means each connected to receive said reference signal and the

output signal of a respective one of the transducers and operative to produce a digital output signal which is representative of the time difference between the reference and received input signals;

whereby said digital output signals define x and y coordinates of the point of impact on the sheet.

In one preferred form, positions of the sheet identify alphanumeric characters, and the manual input of a character is made by causing an impact at the appropriate position. This may be done simply by tapping the sheet with the finger, but preferably some form of mechani'sm is provided for better accuracy and uniformity. Such mechanism may comprise typewriter-style keys, or a bubble film.

The sheet is preferably glass, but other materials of low acoustic absorption and good mechanical stability may be used. The reference signal means may suitably comprise a continuous conductive coating on one side of the sheet, and means carried by the keys or the like for closing an electrical circuit at the same time as causing an impact on the sheet. A metal of suitable acoustic properties may be used, in which case no conductive coating will be required.

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic plan view of one device embodying the invention;

Fig. 2 is a scrap sectional view, to an enlarged scale, taken on the line 2-2 of Fig. 1;

Fig. 3 is a block diagram of circuitry which may be used with the device of Fig. 1;

Fig. 4 is a scrap sectional view of a second embodiment; and

Fig. 5 is a similar view of a further embodiment.

Referring to Figs. 1 and 2, the device comprises a rectangular sheet of glass 10 which has an electrically conductive metallised layer 12 (Fig. 2) on its upper surface. The sheet 10 is overlaid by thin metal sheet 14, suitably of beryllium, formed with rows and columns of bubbles or dimples 16 which act as keys. The metal sheet 14 is connected to a low voltage source indicated at 18. Attached to adjacent edges of the glass sheet 10 are two 2 MHz ultrasonic transducers 20 and 22. The bubbles 16 are labelled in any convenient manner to indicate alphanumeric characters.

The transducers 20,22 preferably extend along the whole of their respective edges, and suitably comprise strips of a polymeric piezoelectric film such as the polar forms of polyvinylidene fluoride (PVDF). One suitable form is sold as KYNAR (Trade Mark) film by Pennwald Corporation, King of Prussia, PA 19406, USA.

When a chosen bubble 16 is pressed, it clicks into the reverse position shown in dotted form in Fig. 2. This has two effects. First, it makes an electrical contact between the metal sheet 14 and the layer 12, giving an output signal on line 24 which is used as a timing reference signal. Secondly, the bubble 16 makes an impact on the glass sheet 10 which causes an acoustic wave to radiate from that point at sonic velocity. Receipt of the shock wave at the transducers 20 and 22 causes outputs on lines 26 and 28 respectively. The time intervals between the signal on line 24 and the signals on lines 26,28 are proportional to the x,y coordinates of the point of impact, and thus define the position of the bubble 16 operated. The electronic circuit of Fig. 3 can be used to process this information into a digital form.

Referring to Fig. 3 the voltage change on line 24

starts two timers 30,32. Each timer is connected to a respective crystal 20,22. When the pulse is received by a crystal it passes through a detection network 34,36 and sets a trigger 38,40 which stops the timer 30,32 and closes an electronic gate 42,44 for the period of time taken for mechanical bounce to die out, thus protecting the circuitry from multiple bounce on the keys.

When the gates 42,44 open again the counters are reset to zero to await the next key instruction.

By suitable choice of the clock frequency and type of counter, the output from the counters can be in directly usable binary coded form representing the chosen character.

The embodiment described thus provides a very simple and inexpensive means of entering data while being similar, from the point of view of the user, to a conventional keyboard.

It has been found that with readily available components a positional resolution on the glass plate of a fraction of a millimetre can be achieved. This can be utilised in a modification of the above embodiment. A number of bubble sheets similar to 14 above are provided, each sheet being mountable at a slightly different position on the glass sheet. The bubbles on each sheet can then represent a completely different character set from those on other sheets.

It is also possible to use the input device of Figs. 1 and 2 without circuitry of the kind illustrated in Fig. 3 for computer input. The timing of signals on lines 24,26,28 and subsequent decoding of the input characters can be handled by the computer processor, via a suitable analog interface, under the control of suitable software.

The timing reference signal could be generated acoustically rather than electrically, by forming an acoustic transducer over the whole of the undersurface of

the glass plate.

Fig. 4 illustrates an embodiment in which similar principles to those used in Figs. 1 to 3 are applied to a graphical input. Parts which are similar to those of the previous embodiment have like reference numerals. The glass sheet 10 in this embodiment is provided with a matrix of fine grooves 46 in both x and y directions on its upper surface. The user "draws" on the surface with a metal stylus 48; as this crosses each groove it causes an impact whose x,y location is identified as previously described. The path traced by the stylus is thus defined as a series of x,y coordinates.

A further embodiment is illustrated in Fig. 5 where again like reference numerals denote like parts. The glass sheet 10 is in this instance overlaid with a sheet 50 of PVDF secured to it with adhesive (not shown). A signal generator 52 applies tone bursts of an oscillatory electric signal to the PVDF sheet 50, which because of its piezoelectric nature vibrates at the same frequency. When a key, diagrammatically shown at 54, is depressed by the user, the PVDF sheet 50 is mechanically compressed onto the glass sheet 10 causing ultrasonic energy to be coupled into the glass at that point. The x,y coordinates of this point are then determined as before. At points of the PVDF sheet 50, which are not compressed, the sheet vibrates freely and dissipates energy to the air. Timing may be initiated electrically as before, via a metallised top layer 56 adhered to the PVDF sheet 50, or may be initiated directly from the signal generator 52.

In a modified version (not shown) of this embodiment, the PVDF sheet is locally compressed by a hand-held stylus, timing being initiated directly from the signal generator. The tone bursts may be applied to the PVDF sheet, or alternatively may be applied via the stylus itself.

In this embodiment, the signal generator produces bursts of a given frequency. The frequency may be around 2 MHz for a low resolution application, e.g. a simple keyboard. Much higher frequencies may be used, for example up to 30 MHz which would give a positional resolution of 0.1 mm. A frequency much below 2 MHz would be likely to introduce inaccuracies due to "whipping" movement of the glass sheet.

The PVDF sheet should have such a thickness that its resonant frequency is matched to the signal generator frequency. The acoustic receivers should be tuned to the same frequency, or pass their outputs via filters which remove lower frequencies, for maximum resolution.

There are two specific differences between the present invention and previous acoustically located data input systems. They are the fact that it is located in both x and y and that a system is defined for producing an accurate start signal for the timers to accurately locate the key position. Secondly, the use of high frequency electronic receivers to give a very high resolution. It will be seen that these features make possible the electronic sketch pad mentioned. Another important feature is that due to the very high signal levels available from the keyboard only four wires are required to connect the keyboard irrespective of the number of keys. Because of the size of the transducers in most applications they will behave as quite low impedance sources providing a sufficiently powerful signal to drive reasonably long cables.

CLAIMS

1. A data input device comprising:

a sheet of material having known acoustic transmission properties and having two edges at an angle to each other (preferably a right angle);

first and second acoustic transducers each arranged on one of said edges and responsive to the receipt of an acoustic pulse at the respective edge to provide a corresponding electrical signal; and

reference signal means associated with said sheet and operative to provide a reference signal in response to an acoustic event at any point on the sheet.

2. The device of claim 1, wherein said acoustic event is an impact, the device including means for selectively producing an impact at predetermined points on said sheet.

3. The device of claim 2, in which said impact producing means is a plurality of manually operable movable elements.

4. The device of claim 2, in which said impact producing means comprises grooves formed in said sheet for cooperation with a stylus.

5. The device of claim 1, in which said sheet is overlaid with a sheet of piezoelectric material, and including signal generating means coupled to said piezoelectric material to cause it to vibrate and means for locally compressing said piezoelectric material to cause its vibration to be coupled into said sheet, such coupling constituting said acoustic event.

6. The device of claim 5, in which the local compressing means comprises a plurality of manually operable movable elements.

7. The device of claim 5, in which the local compressing means comprises a stylus.

8. The device of claim 7, in which the signal generating means is coupled to the piezoelectric material via the stylus.

9. The device of any preceding claim, further including:

first and second signal processing means each connected to receive said reference signal and the output signal of a respective one of the transducers and operative to produce a digital output signal which is representative of the time difference between the reference and received input signals;

whereby said digital output signals define x and y coordinates of the point of impact on the sheet.

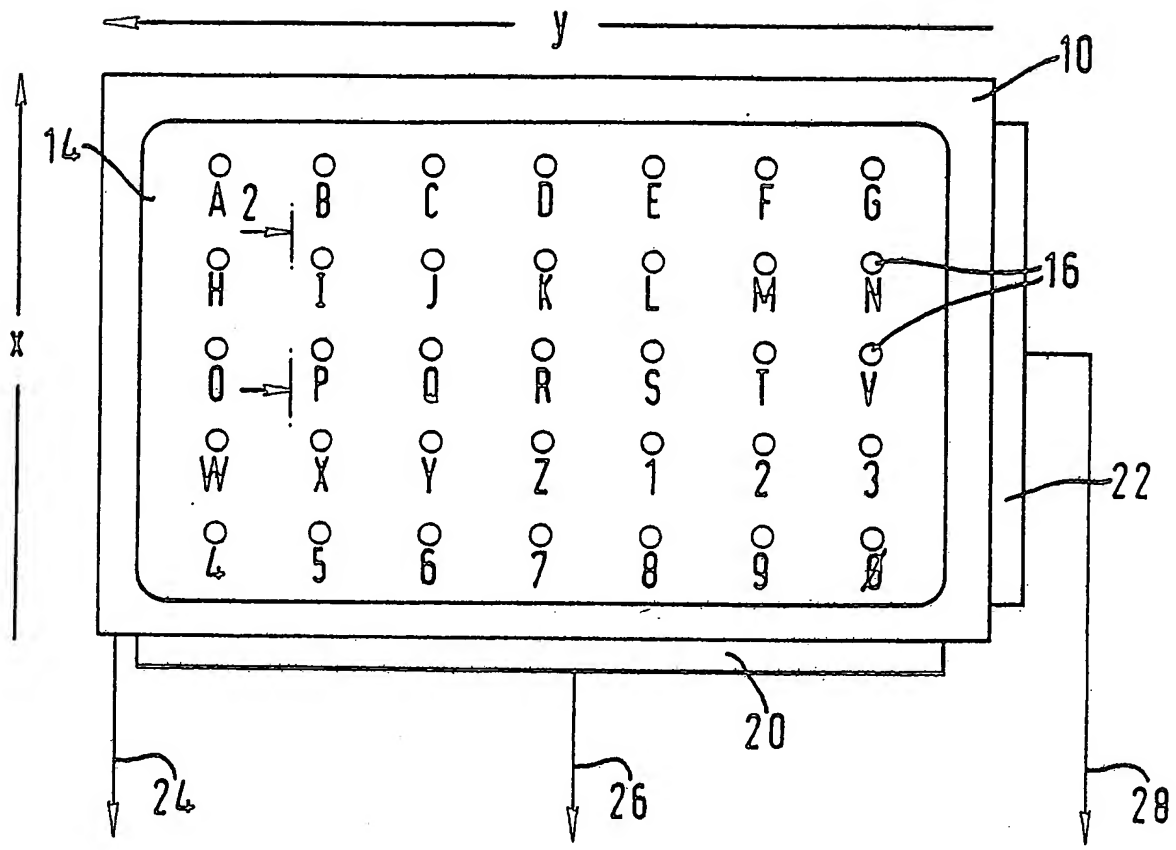

FIG. 1.

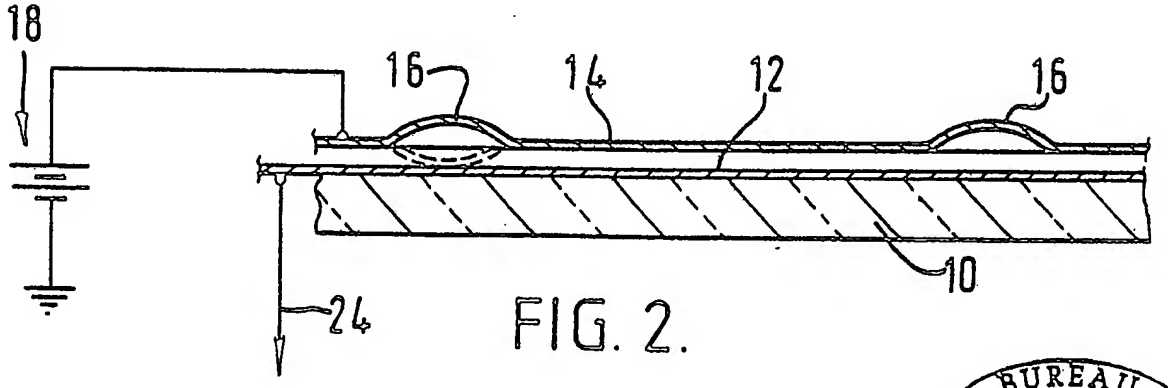

FIG. 2.

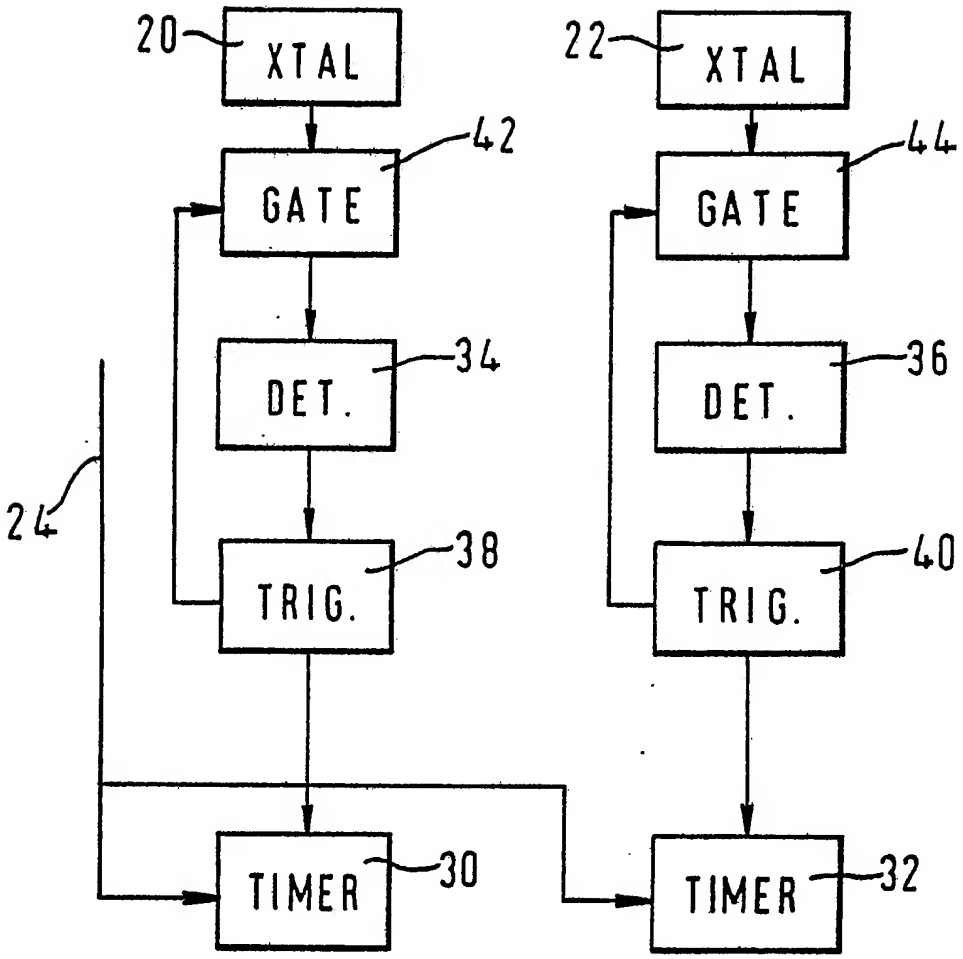

FIG. 3.

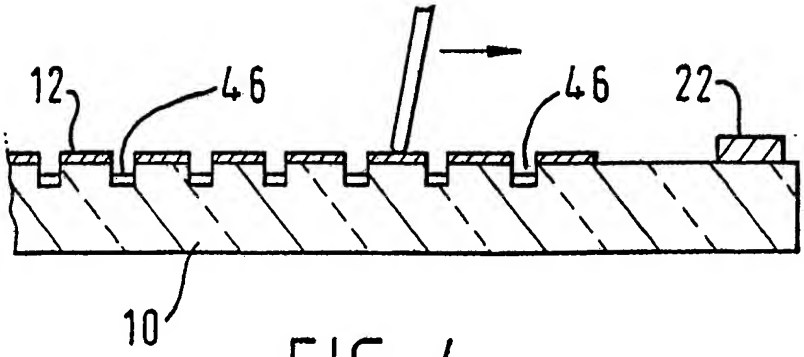

FIG. 4.

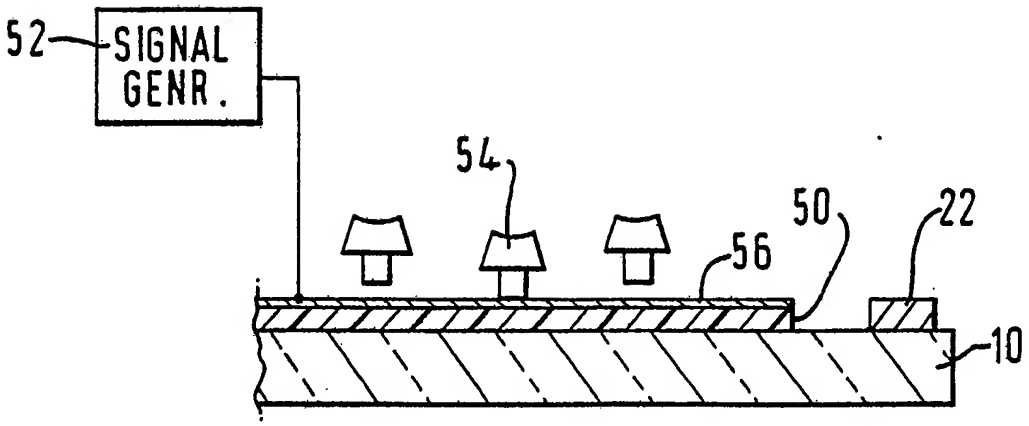

FIG. 5.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 83/00170

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[3]: G 06 K 11/06

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC[3]	G 06 K

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X Y	IBM Technical Disclosure Bulletin, vol. 20, no. 7, December 1977 (New York, US) J. Fajans: "A coustical touch panel", page 2925, see the entire article	1,2 3,5,6,7, 8
X Y	-- US, A, 3808364 (RICHARD VEITH) 30 April 1974 see abstract; figures 1,2; column 3, lines 29-62	1,2,9 5,6,7,8
Y	-- IBM Technical Disclosure Bulletin, vol. 12, no. 11, April 1970 (New York, US) S.F. Kanbic et al.: "Multistylus keyboard for manual stylus interactive interface", pages 1863-1865, see figure 3; page 1864, line 34 - page 1865, line 8	3,6
	--	./.

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
7th October 1983	08 NOV 1983
International Searching Authority [1]	**Signature of Authorized Officer [20]**
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No 18
A	IBM Technical Disclosure Bulletin, vol. 18, no. 4, September 1975 (New York, US) L.E. Ambrico et al.: "Cordless stylus for ultrasonic tablet", pages 1078-1079, see the entire article	1,2,9
A	US, A, 3857022 (NEBANE et al.) 24 December 1974 see figures 1,2; column 2, lines 14-51	1,2,9

ANNEX TO The INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 83/00170 (SA 5477)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 27/10/83

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 3808364	30/04/74	NL-A-	7204259	03/10/72
		FR-A-	2131681	10/11/72
		DE-A,B,C	2142676	08/03/73
		LU-A-	65055	03/10/73
		GB-A-	1384313	19/02/75
		CH-A-	567306	30/09/75
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		AT-A,B	336092	12/04/77
		DE-A,C	2115367	19/10/72
		US-A-	3806642	23/04/74
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		BE-A-	781487	02/10/72
		SE-B-	378924	15/09/75
US-A- 3857022	24/12/74	None		